Repairing Mechanical Watches & Clocks

A Complete Series of Bench Practices

Correcting the Bent Hairspring, Part V

By Henry B. Fried, CMW, CMC, FAWI, FBHI, ★FNAWCC

Too often the young watchmaker is prone to abandon a bent hairspring. He sends the balance away to have a new hairspring vibrated or buys a complete new balance. This delays the job and decreases the profit.

It is better to use the old spring, since it was matched to the balance at the factory and you know that it has kept agreeable time

With practice, one can become proficient at correcting bent hairsprings. The amazing facility with which workers in watch factories and watchmaking teachers correct hairsprings is the result of constant practice. However, aside from practice, some logical procedures in correcting hairsprings will help.

Sometimes a hairspring has become tangled; one coil has overlapped another until it almost seems knotted. Most often this type of tangle is caused by a sudden side jarring of the balance while it is out of the movement.

Overlapped Hairsprings

A "simple" tangle is shown in Figure 32. If the hairspring and balance were as large as this figure, it would be easy to discover that this is not a tangle in the true sense but rather an overlapping of one coil onto another.

Untangling is simple. Grasp the balance bridge with the prongs of one tweezer and the balance with another or with the fingers of the other hand. Stretch the two apart considerably out-of-axis, as shown in Figure 33. The errant coil (designated by the arrow at A) will slip off the upper coil upon which it is resting and assume its natural position. Be careful not to over-flex the hairspring or it will become bent and distorted.

Avoid Kinking the Spring

If the tangle is situated low on the hairspring near the collet, it is difficult to free the errant coil without kinking the hairspring. Therefore, first bring the tangle closer to the stud or regulator.

Grasp the balance bridge with one tweezer and the balance rim with another or between the thumb and forefinger of the other hand. Pull the balance away from the bridge, causing the hairspring to become a descending, diminishing tapered helix. Now in this position, pull the balance to one side as in Figure 33, but move the balance in a circular path.

Bring Nearer the Stud

If the hairspring develops from the stud toward the collet, clockwise, move the stud or its holder counterclockwise. This brings the twist nearer the stud and the larger coils where it can be more easily observed and manipulated.

If the hairspring develops from the stud to the collet, counterclockwise, turn the stud or its holder (the balance bridge) clockwise as in Figure 34. This brings the tangle nearer the larger coils at the top where it can be manipulated without bending or kinking the hairspring.

If the tangle develops close to the collet, the above process should not be used. Instead, the tangle should be eased up to a position closer to the outside of the hairspring.

Using a Needle

First remove the balance from the bridge. Then use a fine, thin needle set into a pegwood holder, or your finest oiler ground to a polished point. Place the needle point between the coils, close to the collet. Gently follow a path outward in the space between the coils as shown in Figure 35. When the needle comes to the point of the tangle, a gentle nudging outward will spread the tangle apart and ease it toward an outward spiral direction. Continue this until the tangle is at a position nearer the outer larger coils.

Now untangle the coils as explained previously or continue to work the needle outward until the tangle reaches the stud. The stud can then be manipulated out of the lower coils by holding the sprint nearer the collet with one pair of tweezers and manipulating the closest coil with another.

Tangled Hairsprings

A true tangle is one which took place while the balance was disconnected from the bridge. The stud has threaded itself through the inner coils of the hairspring. Such a hairspring, if drawn tighter, becomes knotted. The tangle must be brought up to the stud and threaded

through the last coil, using two pairs of tweezers.

A simple way of untangling a hairspring—preferred by many watchmakers—is to separate the tangled part from the untangled with a piece of white tissue paper.

Suppose the hairspring is tangled near its center, about the sixth coil. Allow the balance to hang from the hairspring, distending it. Insert the piece of tissue a coil or two below the tangle. Grasp the tissue paper in the fingers of one hand, allowing the balance to hang by the few coils below, supported by the tissue as a hanging shelf.

Now grasp the outer coils with a sturdy tweezer and twist in the direction which will cause the section of the hairspring above the tissue to thread itself below the tissue. This is shown in Figure 36. The tangle will be forced gently to the top outer coils near the stud where it can easily be unthreaded with another pair of tweezers.

Consider the Collet

This method is not good when the tangle is near the

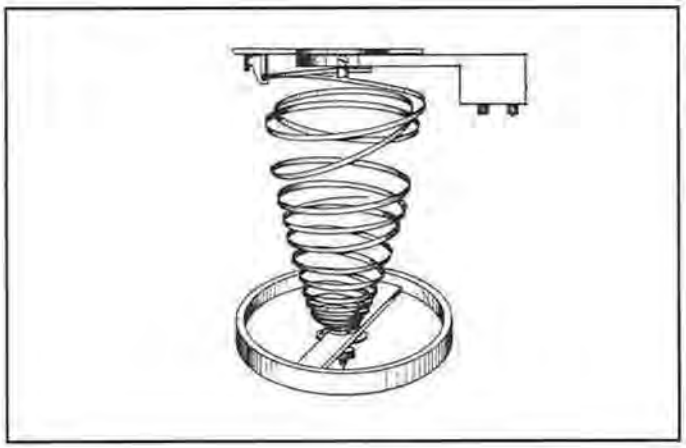


Figure 32. A "simple tangle" is actually not a tangle at all but an overlapping of one coil onto another. It is caused by a sudden jarring of the balance.

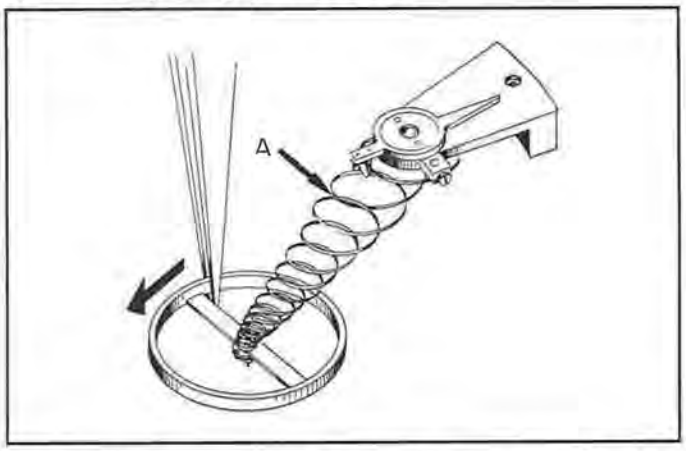


Figure 33. A simple tangle unravels automatically when the hairspring is stretched out-of-axis. Grasping the balance bridge with a tweezer, stretch the spring up and out in a circular path.

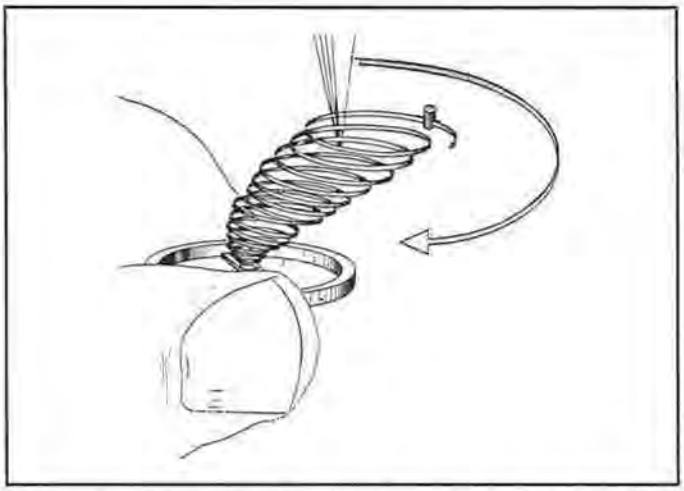


Figure 34. If the spring develops from the stud to the collet, counterclockwise, turn the balance clockwise. This brings the tangle nearer the larger coils at the top where it can be manipulated more easily.

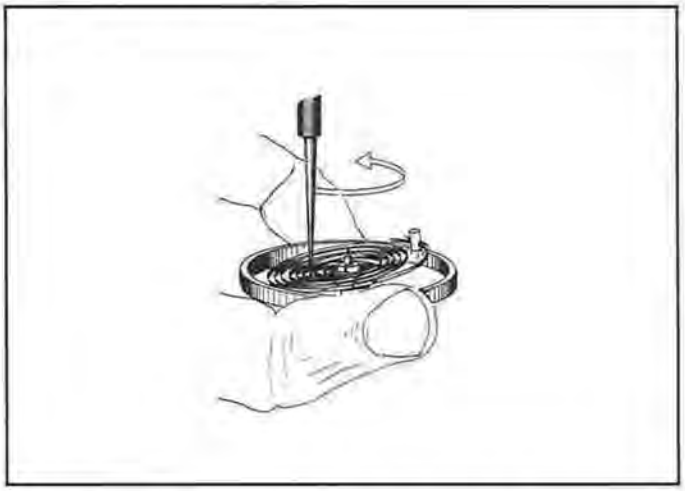


Figure 35. If the tangle is close to the collet, move it out to the larger coils by tracing a path with a needle. First, the balance must be removed from the bridge.

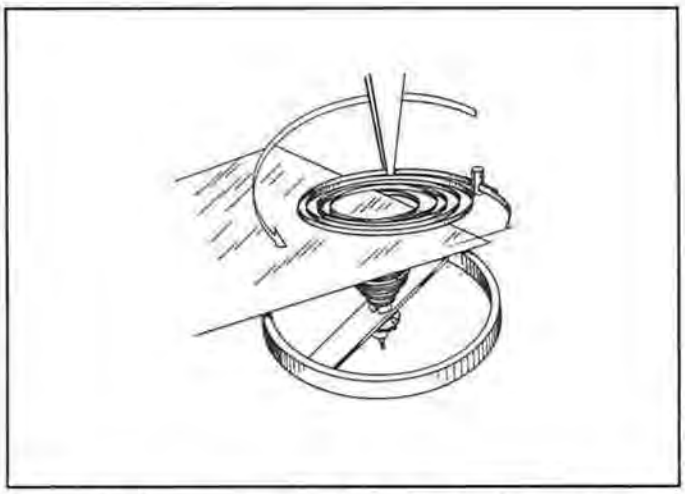


Figure 36. In a true tangle, the spring has become knotted while it was removed from the balance bridge. Use a piece of tissue paper as a shelf on which to hang the spring. Insert the paper a coil or two below the tangle.

collet. It may cause the closely-coiled inner spring to bend upward. In such a case it is better to use the thin needle, as illustrated in Figure 35.

If the spring contains more than one tangle or if the stud seems to be threaded into a few coils of the hairspring, it is wise to remove the hairspring from the balance. The temptation to force the hairspring coils apart to a distance greater than their natural resiliency might cause the stud to bend the hairspring.

Use a Scaffold

A good way to hold the hairspring while out of the balance is to mount it on a balance scaffold, which you see in Figure 37. This is a tapered pin set into a heavy metal block. Place a white piece of paper over the pin to provide a contrasting background which will reflect light. The scaffold allows the use of both hands, though one hand generally grasps its base. Be careful that the pin is not so long that it might injure the eye.

One Tangle at a Time

Should the spring have more than one tangle, try to bring one of these tangles at a time up to the outside of the spring. Otherwise you will badly tangle the spring, kinking the coils. Sometimes when two coils are entwined closely, or two tangles contained in one, it is better to separate them singly. Even if these are outward near the stud, it is advisable to bring the inner tangled coil a bit closer to the collet. Then you will not be confused as you take care of the one outer tangle by itself.

Note Stud's Position

If the tangle is so complex that it is confusing and the stud is in the way, remove the stud, first noting exactly its position on the hairspring for later replacement and correct timing. The tangling can then be unraveled without difficulty.

In some cases of tangling, the spring (when off the balance bridge) has become hooked by its stud around

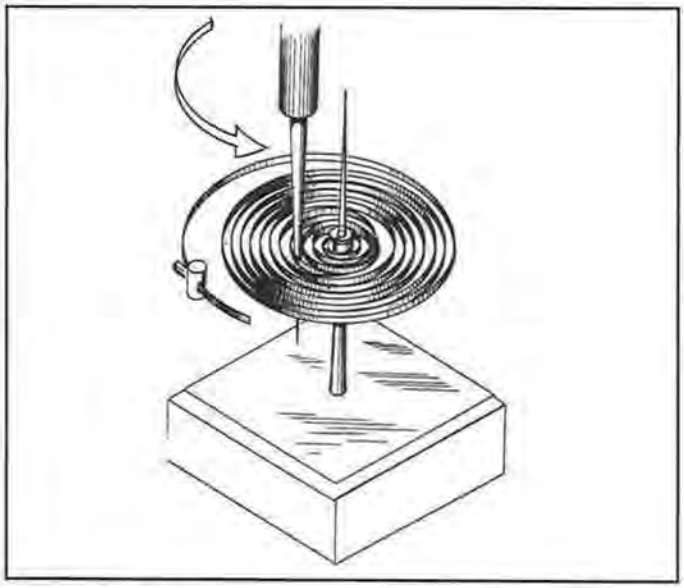
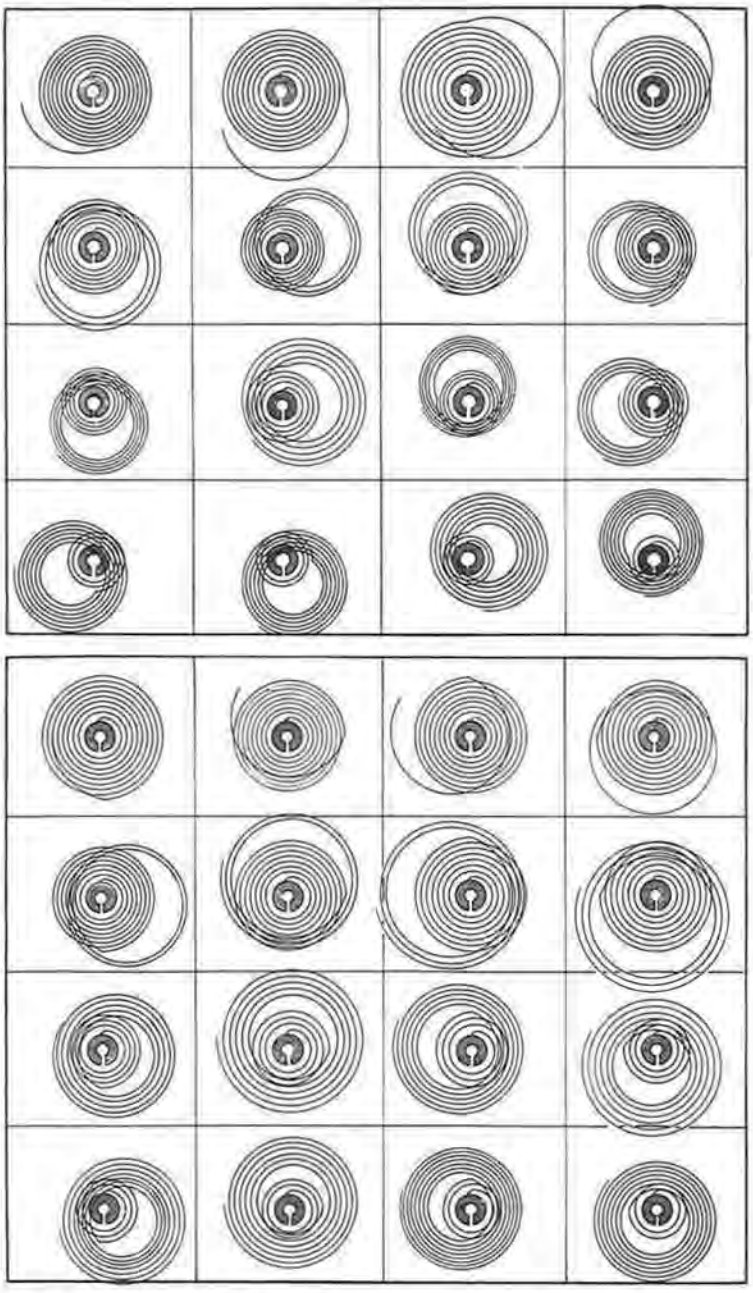


Figure 37. A good way to hold the hairspring when it is out of the balance is to mount it on a balance scaffold. Make one by setting a tapered pin into a heavy metal block.



Figures 38 & 39. A series of projects on hairspring correction supplies necessary practice and establishes a pattern of procedure for the beginner. Figure 38 shows progressive stages of bending and correcting outward hairsprings. As the project brings the bend closer to the collet, the job becomes increasingly difficult. After correcting a series of outward bends, the student is made to bend a spring inward and correct the bend one-quarter turn at a time approaching the collet. This is illustrated in the 16 diagrams shown immediately above in Figure 39.

the rim of the balance wheel. This is easily recognized by noting whether a coil of the spring is looped over the circumference of the rim. In that case, grasp the stud in the tweezers and thread it out of the rim. If this happens in the old, split-compensation (bimetallic) balance, grasp the stud and ease the body of the spring near the stud back through the split in the balance.

Keep Unit Intact

In practically all cases of tangling, it is better to allow the hairspring to remain on the balance. The hairspring can be handled more easily, and is not so sensitive to bending. Also, the weight of the balance assists in separating the coils in a vertical helix, making it easier to observe and select a particular coil with the tweezers.

Use the sturdiest tweezer that can discriminate between the coils. This permits a surer grasp of the spring and guards against kinking the coils. Make certain, however, that the tweezers are in good condition—smooth and without burrs—and that the blades of the tweezer are of equal length, width, and thickness.

❐

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by J.D. OLSON

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Correcting the Bent Hairspring, Part VII

By Henry B. Fried, CMW, CMC, FAWI, FBHI, ★FNAWCC

Bent Hairsprings

Bent hairsprings are of two types: those which tilt from the main body and level of coils to occupy different levels, called "out-of-flat"; and those which cause the spiral development to become disorderly and unequal, called "out-of-round."

Choosing the Right Tools

Hairspring tools consist of finely pointed tweezers and long, thin, polished needles set into light holders such as pegwood or plastic sticks. Only the most delicate pointed tweezers should be used for work near the collet.

Experienced watchmakers and hairspring workers prefer short, pointed tweezers over the long tapered types. Short tweezers are stronger, yet can reach in between most coils of the hairspring. The strongest tweezers possible should be used, as they permit you to get closer to the work and they relay greater sensitivity while making corrections.

Find the Bending Point

The first step in attempting to correct a bent hairspring is to find the source of error, or the bending point. The exact spot of the bend can be elusive because it might be hidden under another coil. In some cases the bend is so gradual that its exact beginning is difficult to find.

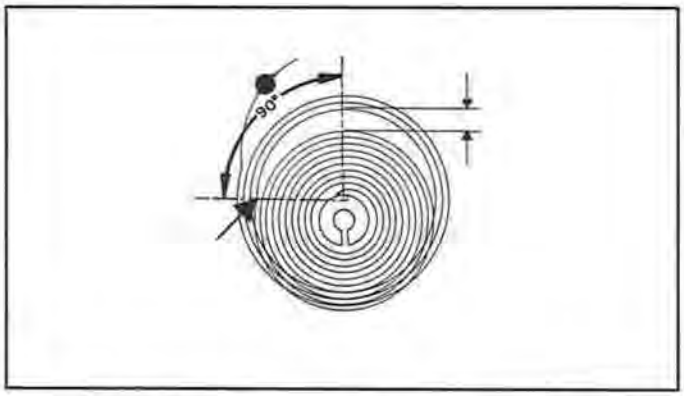

Figure 40. Before attempting to repair a bent hairspring, locate the exact bending point of the coil. You will notice with an outward bend that there is an area of greatest space between the coils. Progressing inward toward the collet, the source of the turn is 90 degrees, or one-quarter turn around, designated by the arrow.

Figure 40 shows a hairspring bent outward in-the-round. The bend is a sudden, sharp deviation and easy to spot. Notice that when a spring is bent outward there is an area where the space between the coils is greatest. The source of the bend is one-quarter turn inward toward the collet.

On Figure 40 a cross-line illustrates a system for locating the deviation point. The area of the greatest space between the coils is at 90 degrees to the bend itself.

Correcting the Outward Bend

After determining the point of bending, grasp the spring with tweezers at this point but a little behind the bend, closer to the collet as shown in Figure 41. If the bend is near the outer end of the hairspring, nudge the hairspring with a finger of your free hand. You will have a more direct and sensitive touch than if the "feel" has to go first through a tool and then to the fingers.

The tweezers act as a vise, while you nudge the entire section of spring outward of the bend. Do not be concerned that the nudging finger is actually pressing on the outer coils, as in Figure 42. The spring will only bend at the point held by the tweezers. Using the finger whenever possible is the safest method. There is less chance of introducing a new bend in the "fault."

If you use two tweezers, grasp the hairspring with one and use the second closed, as you would a needle. If both tweezers are grasping the spring, any shake or miscalculation will result in a new bend, similar to that in Figure 43.

Rather than chance excessive bending or new bends in the opposite direction, nudge the spring lightly and repeatedly so that the bend back to normal is made in gradual increments.

Compounding the Problem

If the bend is close to the collet, do not use the finger to nudge the hairspring directly. A fine polished needle set into a pegwood stick is best. Grasp the hairspring with the tweezer, as usual. Sometimes if the bend is close to the collet it is advisable to grasp the hairspring on the side of the bend closest to the *stud* and not the collet. This al-

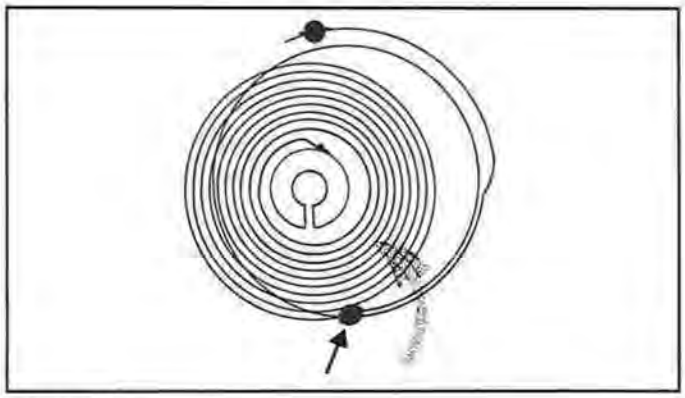

Figure 41.

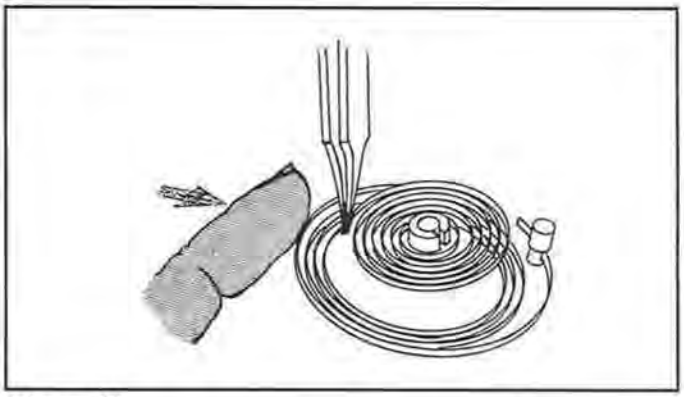

Figure 42.

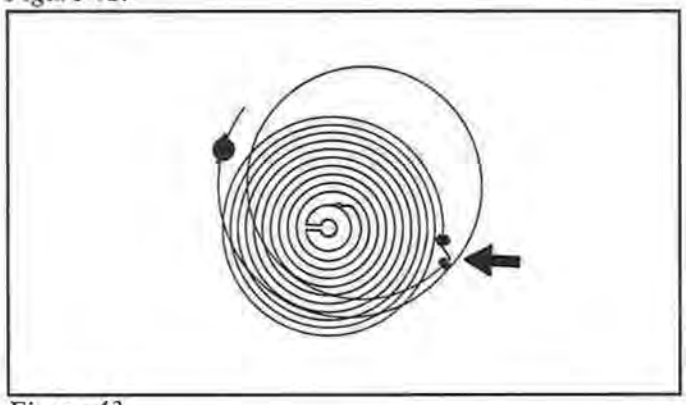

Figure 43.

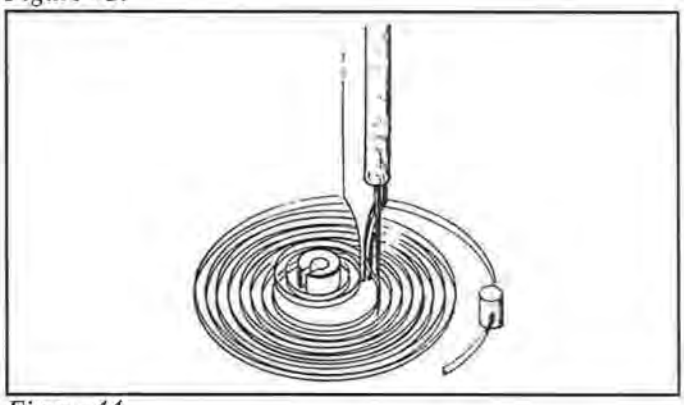

Figure 44.

Figures 41, 42, 43, and 44. To correct an outward bend, grasp the spring with tweezers just behind the bend as shown in Figure 41. Using your finger, as in Figure 42, nudge the section of spring outside the bend. The tweezer acts as a vise. If you prefer to use a second pair of tweezers, use it closed. If both pairs grasp the spring the slightest shake will result in a new bend, as in Figure 43. A polished needle is best to nudge a bend so close to the collet as in Figure 44.

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lows the needle to nudge the spring and collet back to normal gradually, as in Figure 44.

If there are two or more bends in the hairspring, correct the more severe bend first. This restores at least a partial appearance of an orderly spring and lessens the confusion of coils overlapping each other. If multiple bends cause confusion, the simplest procedure is to correct the outermost bends first, working gradually toward the center. Then more critical and exact corrections can be made afterward.

Again, a reminder—moderately pointed tweezers are recommended for correcting coils near the stud, while finer tweezers are needed closer to the collet. Near the collet the radii of the curves are shorter and sharper. Therefore, any corrective force exerted near the collet has a greater effect and causes a sharper bend than the same force applied to a coil near the stud.

When a coil has been bent inward, as in Figure 45, it looks in worse condition than one with an outward bend. This is because the coils cross one another and, as does Op art, confuse the eye as it follows a spiral path along the spring to pinpoint the bend. Actually, an inward bend is easier to correct.

Determine the bending point with the same 90-degree method described earlier. The one exception with an inward bend is that because the fault has caused a diminishing of space, we trace it from the point of *least* space back one-quarter turn toward the collet.

Manipulate a pair of tweezers with flat inside surfaces so that the blades straddle the bend, as in Figure 46. Pinch the tweezers gently to bring out the bend and restore the curve. If you squeeze too tightly, the bend will be overcompensated. It will then have to be corrected as if it was an outward bend, which we described previously.

The Gradual Bend

If a spring has been bent so slightly that the bend is not sharp and cannot be spotted easily, it becomes more important to discover the exact point of deviation. Otherwise, an inexact point of correction will only introduce a new bend.

Follow the path between the coils outward from the collet with your eye until the space between the coils either diminishes or becomes greater. Then use the 90-degree method to determine the bending point.

Figure 47 shows an example of a bend which confuses efforts to correct it because it appears that there are a number of bends. Actually, there is only one bend, situated at A. This bend has caused the spring, one-quarter turn outward, to press against the adjacent coils and force them to touch one another at B. This, in turn, has caused the spaces diametrically opposite to become a like amount greater, at C, D, E, and F.

In such a case, pinch the hairspring at A to bring the coil outward. This relieves the pressure against the two inner coils at B and diminishes space F back to normal.

Again, pinching the spring when a bend is closest to the collet has a greater effect than the same manipulation closer to the stud. A glance at Figure 48 makes this clear.

Gradual bends can be corrected by a series of small bends, each close together to form a gradual curve resembling the correct spiral. Sometimes the correction can be made with the finger, as in Figure 49. Diametrically opposite the anchored bend, push the hairspring with the finger to hump up that portion of the spring momentarily and restore the correct curve. Of course, take care not to overbulge the spring.

Crinkled Hairsprings

Fortunately, crinkled hairspring sections are usually confined to the area near the stud. They are often caused by pinching from the pins of a nearby regulator. Inexperienced corrections further the crinkle while the spring is still attached to the balance bridge.

The corrective procedure is literally an ironing-out of the spring using two pairs of tweezers. With the stronger of the two, grasp the good portion of the spring tightly. With the weaker tweezer, preferably one with an oiled smooth inner surface, grasp the spring as close to the strong tweezer as possible and lightly move it away from the strong tweezer, as in Figure 50. Repeat this operation, increasing pressure on the spring until it is free from crinkles. Then correct the curve as with a gradual bend.

Some watchmakers correct crinkles by resting the spring edgewise on a polished piece of white glass. The glass provides a smooth surface and contrasting background. Then rub the hairspring with the back of a rounded tweezer or polished needle. While the needle irons out the crinkles, it also causes the hairspring to curl upward, assuming nearly the curve which it formed originally.

By all means do not grasp the stud with the tweezer while ironing out the spring with another tweezer. This will only result in tearing the spring at the stud.

If correction must be made close to the stud, grasp the spring so that at least a tweezer's point breadth of light can be seen between the tweezer point and the stud. Then turn the spring so the stud points downward, enabling more of the spring to be seen and pinched. Hairsprings are weakest at the points where they enter the collet and the stud because the pinning and bending operations have already put these points under stress.

Many studs have two diameters. The larger is on top, while the smaller one bearing the spring is below. Turning the spring on its face allows the tweezer to get directly at the point where the spring enters the stud.

Correcting hairsprings which are bent out of flat is more difficult than correcting those which are bent out of round. If you place an out-of-round hairspring on a flat white background, you can watch the fault while you correct it. But in order to see the fault in an out-of-flat hairspring you must lift the spring and view it from the edge, select the bending point from the other coils, then lay it down again and remember the exact spot while proceeding to correct it. ❐

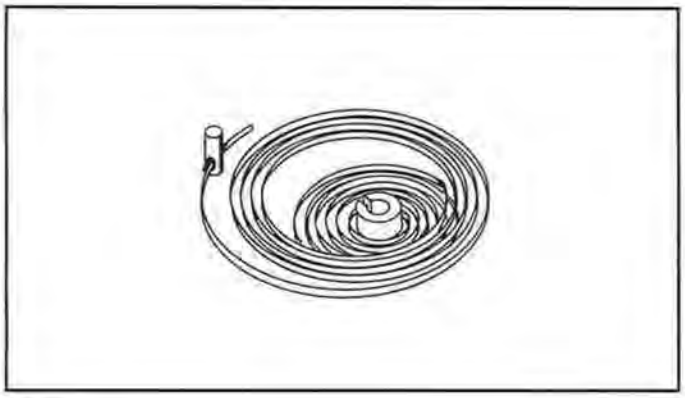

Figure 45.

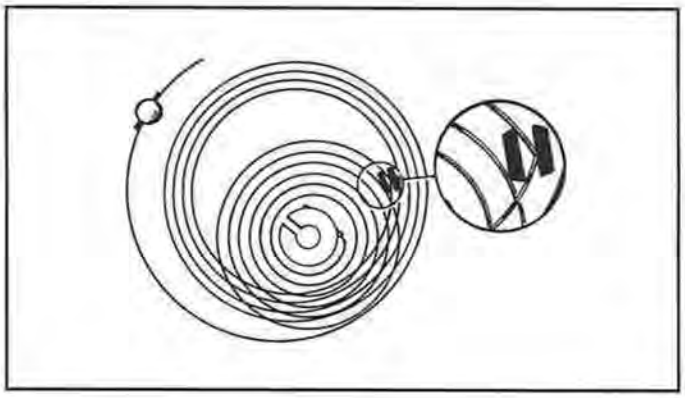

Figure 46.

Figures 45 and 46. An inward bend, such as in Figure 45, looks more confusing because the coils appear to cross each other. Correct the bend by pinching gently between a pair of flat-surfaced tweezers, as in Figure 46.

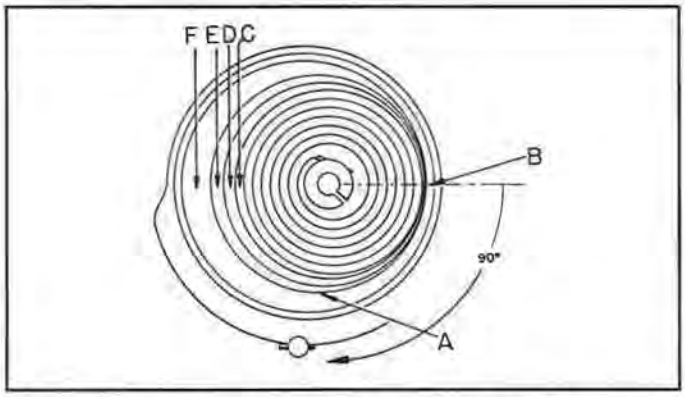

Figure 47. A gradual bend, at A, forces adjacent coils to touch one another at B, creating larger spaces at C, D, E, and F.

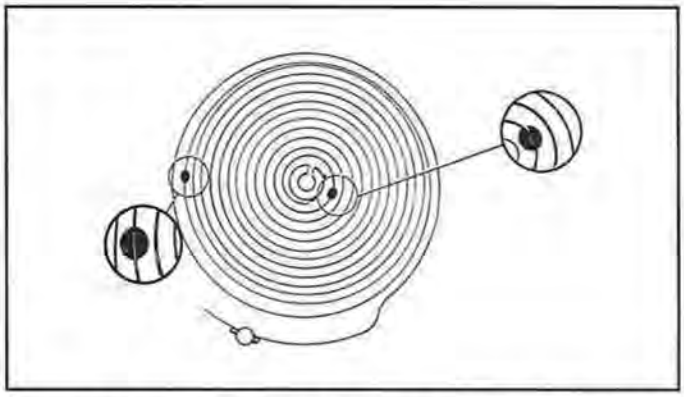

Figure 48. Pinching a bend in a coil near to the collet has a greater effect because of the more pronounced curve of the coil.

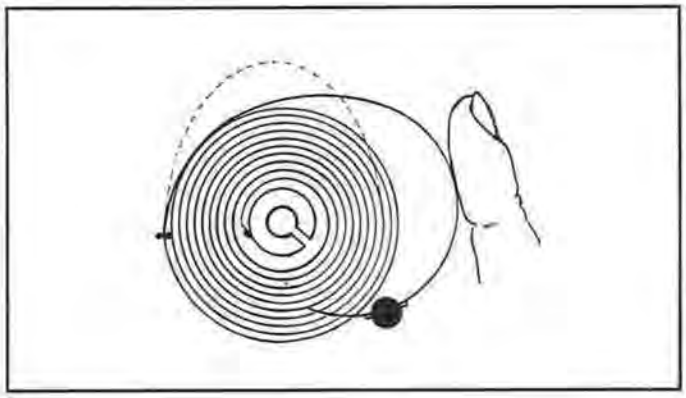

Figure 49. A gradual bend can be corrected by a series of small bends formed by humping the spring with the finger.

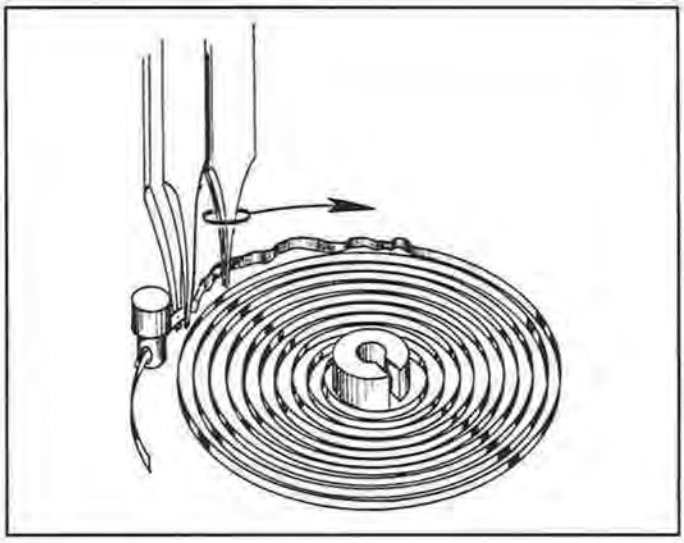

Figure 50. A crinkled hairspring is corrected by stretching or ironing out the coil between two pairs of tweezers.

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Correcting the Bent Hairspring, Part VIII

By Henry B. Fried, CMW, CMC, FAWI, FBHI, ★FNAWCC

Find The Bending Point

First we must establish certain principles of procedure. When correcting in the round, the important factor was establishing the point at which the spring was bent. You will remember that this spot was generally found to be 90 degrees inward from the widest (or narrowest) spot between the coils.

When truing in the flat, the point at which the error is situated in the majority of bends is 180 degrees inward from the point of highest deviation between the two levels of the spring. Figure 52 appears as two separate springs. Figure 53 shows the same type of bend, simplified, since it is on the outermost coil. The highest spot is at A. Spiraling inward from A toward the collet 180 degrees, the bending point is found at B.

There are three types of out-of-flat bends: those with coils twisted upward suddenly; those twisted gradually; and those with a "Breguet" bend, similar to the bend in a hockey stick, in which the ribbon of wire is bent against its width.

The best method of correction depends upon the cause of the bend. Usually out-of-flat bends in the last coil are caused when the spring gets caught in a part of the movement while the balance and bridge are being removed from the watch. In such a case, the spring's coils are *pulled* out of alignment. The logical correction, then, would be to *push* them back into alignment.

Gradual Bend

The gradual bend can best be corrected by holding the spring behind the start of the bend with sturdy, pointed tweezers and pushing down on the highest outer half-turn with the index finger of the opposite hand, as in Figure 54.

If the hairspring is small, the finger method may not work too well. A pointed piece of pegwood or a needle set into a pegwood stick is often more successful to nudge the spring back into shape. This is shown in Figure 55.

Sudden Twist

The sudden twist as seen in Figure 56 can also be corrected as in Figures 54 and 55, although some watchmakers would rather correct the kink with two pairs of tweezers. Figure 57 shows how one pair grasps the spring behind the kink closest to the spiral leading to the collet, while the other grasps the spring as close to the first tweezer as possible. Twisting the second tweezer in the direction shown by the arrow removes the kink and helps to level the spring. The vertical tweezer's points should touch the bench.

Breguet Bend

Figure 58 shows a method of removing and correcting an inadvertent Breguet bend. Use a special pair of tweezers with a pin frictioned in one blade, fitting into a hole in the other blade. Grasp the hairspring at the top of the bend and rest it on a block of soft wood *across* the grain, tweezer points down. Now push down on the points into the wood. Usually this method of correction causes the spring to bend out of the round, but this is the easier of the two bends to correct.

To correct bends at the collet, use two pairs of tweezers. Grasp the coil close to the bend and push down (or up) on the opposite side. If the coil is bent at the spot where it emerges from the collet, place the collet over a tapered pin. Grasp the pin in a pinvise, and with another needle set into a pegwood stick, nudge the bend back to a level position. Remember, the closer you get to the collet, the finer the tweezer points required. You recall that bends and their correction are more critical at these central spots than on the outside coils.

Spiral Helix

Sometimes a hairspring is pulled grotesquely out of shape as in Figure 59. This spring looks hopeless. Actually it is one of the easiest to correct, but the method is always impressive to the student as he watches his master.

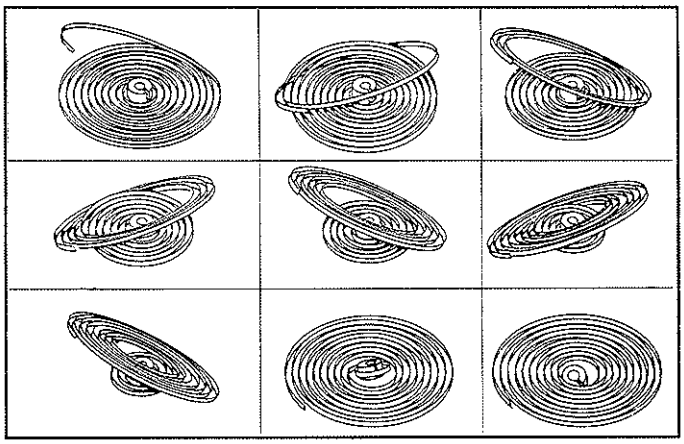


Figure 51. Just as there are exercises to develop skills in truing hairsprings bent out of round, there is a similar set of exercises to increase skills in correcting hairsprings out of flat. At first the spring is deliberately bent upward a half turn, then corrected. This chart shows only the intermediate steps. The complete exercise should show progressive bends of a half-turn until the entire spring has been manipulated. Since the student or his master purposely imposed these bends on the spring, he knows how the bend was inflicted and where it is located.

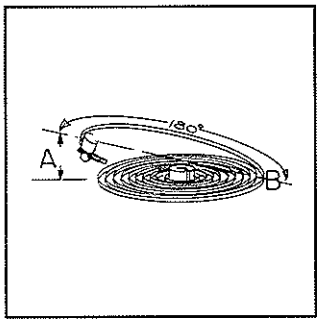


Figure 52.

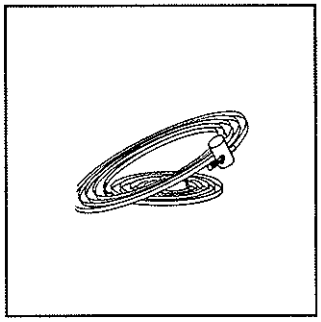


Figure 53.

Figures 52 and 53. When viewed from its edge, an out-of-flat hairspring appears to be two springs, as in Figure 52. Figure 53 shows a simplified example, with the bend on the outermost coil. The bending point is at B, exactly 180 degrees from the highest spot between coils, A.

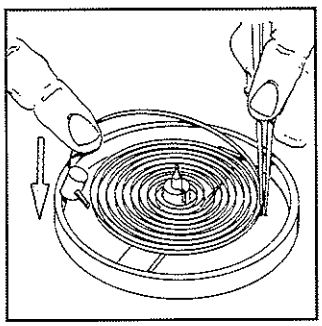


Figure 54.

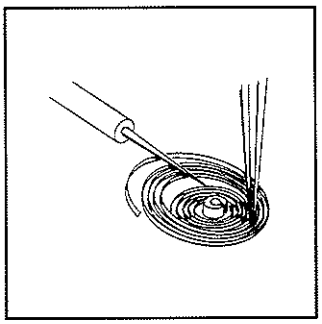


Figure 55.

Figures 54 and 55. A gradual bend can be corrected by grasping the coil with tweezers just behind the bending point and pushing down with the index finger. A needle can substitute for the finger when working with a particularly small hairspring.

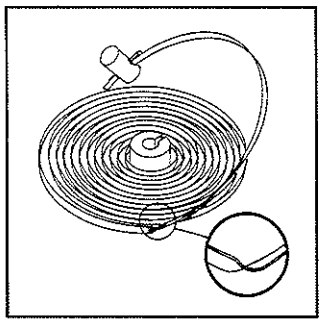


Figure 56.

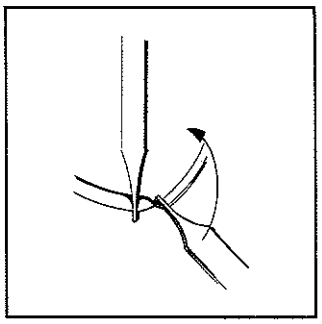


Figure 57.

Figures 56 and 57. Figure 56 shows a sudden twist in an out-of-flat hairspring. Correct it as shown in Figure 57, by twisting in the opposite direction with two pairs of tweezers.

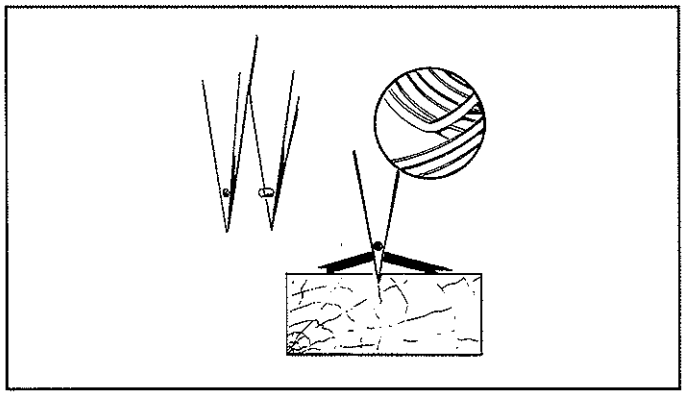


Figure 58. A Breguet bend should be handled with a special pair of tweezers fitted with a pin in one blade and a matching hole in the other, Grasp the hairspring at the top of the bend and rest it on a block of soft wood, across the grain. Gently press the tweezer points into the wood until the bend is straightened.

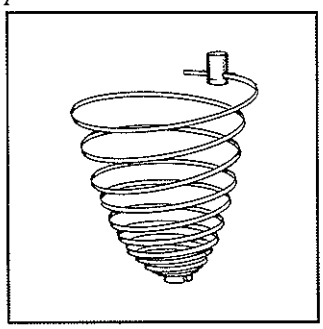


Figure 59.

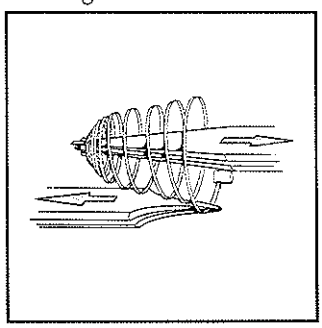


Figure 60.

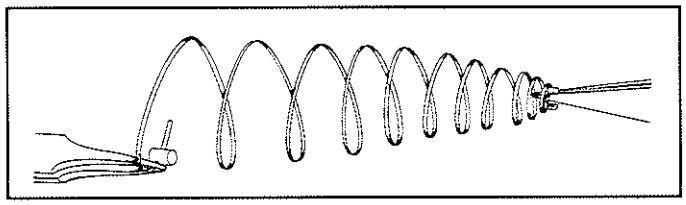


Figure 61.

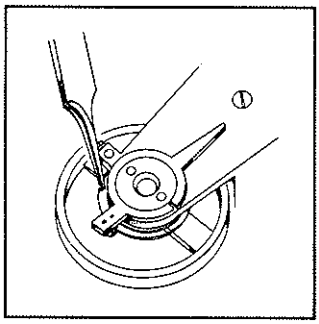
Figures 59, 60, and 61. The spring in Figure 59 has been stretched into a spiral helix. Take it from opposite directions with two pairs of tweezers as shown in Figure 60, one down through the inside of the coil, grasping the collet; the other along the outside of the coil, grasping near the stud. Pull the tweezers apart along a parallel axis until they pass each other and stretch the spring in the opposite direction, as shown in Figure 61.

Such a spring has become a spiral helix, probably because the watchmaker carelessly pulled the balance bridge out of the movement, thinking that the balance, attached to the bridge by its hairspring, would easily follow. In these rare exceptions when it doesn't, the pivot has become lodged in the clogged jewel hole. The result is a spring such as you see in Figure 59.

Remove the spring from the balance. With one pair of tweezers, grasp the collet from the stud side down through the vortex of the spring in the following manner.

Insert one blade through the center of the collet and the other blade along the outside edge of the collet between the collet wall and the first turn of the hairspring. With a second, sturdier pair of tweezers, grasp the hairspring near the stud from the direction of the bottom of the stud, as shown in Figure 60.

Now pull the two tweezers apart along a parallel axis, as illustrated in Figure 61. The pull in the opposite direction must be greater than the distance the spring has been distorted, in order to exceed the point of elasticity and restore the spring to its original condition. Of course don't overdo it! Pull the spring apart in gradual, trial distances. Should you overcorrect the level of the spring, merely reverse the process until the spring is level.



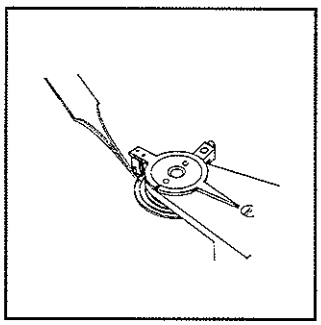


Figure 62. *Figure 63.*

Figures 62 and 63. Sometimes it is advantageous to correct the hairspring while it is still in the balance. If the bend is situated between the stud and the regulator, as in Figure 62, consider the stud as an anchor point and pinch the bend gently with tilted tweezers to bring it back to shape. If the bend is outside the regulator as in Figure 63, consider the regulator the anchor point and pinch the bend in the same manner.

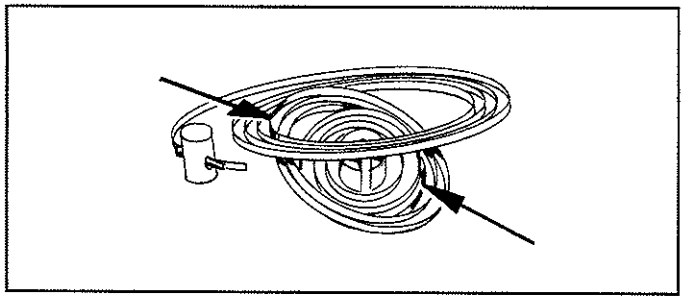


Figure 64. If a hairspring has two out-of-flat bends, treat each section of coil one at a time, working from the collet outward.

Without Removing The Hairspring

Sometimes it is preferable to correct the hairspring while it is still in the balance, especially if the bends are situated in the first one-third turn outward from the stud. This requires a slightly different procedure.

When the bend is situated between the stud and the regulator, consider the stud as an anchor point, acting as tweezers would. Pinch the hairspring near the stud with a pair of tweezers tilted in such a direction to bring the spring up or down to correct its level.

This is a particularly good method of correction when the coil diametrically opposite the stud is interfering with the overlapping center wheel or rubbing on the balance arm, as shown in Figure 62.

When the bend is situated just outside the regulator, consider the regulator as the anchor point. Pinch the spring with a tilted tweezer as shown in Figure 63.

The regulator can be shifted to act as a close tweezer to make corrections at opposite points. Merely move the regulator 180 degrees studwise from the bend. The closer the regulator is, the more effective is the correction.

Do not pinch the spring excessively between the stud and the regulator. This will only cause a secondary bend when and where the spring comes in contact with the center wheel or the bottom of the balance bridge, or when, in the opposite direction, the spring is given a secondary bend at the point where it bears on the toe of the regulator boot.

Always consider a hairspring as being in separate parts divided by the bends. If the spring has just one bend, treat it as being in two sections: one part is the main and correct part spiraling from the collet outward to the bend; the second is that with coils tilting at a different angle from the first part. Should there be two bends as in Figure 64, again treat each section separately, always using the section from the collet outward as a standard.

Proceed by correcting one section at a time. It may be more convenient to correct the outermost bend first, then work inward, but most experienced hairspring manipulators prefer working from the collet outward.

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TECHNICALLY WATCHES

ANTIQUE WATCH RESTORATION, PART CXXVII

TRUING HAIRSPRINGS TO THE BALANCE COCK

By Archie B. Perkins, CMW, FNAWCC, FBHI
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Truing hairsprings to the balance cock is done before the hairspring is placed in the watch for final truing. It is done to minimize the amount of truing needed in the watch.

Truing hairsprings to the balance cock consists of three operations: (1) Circling and centering the regulator sweep, (2) Centering the hairspring collet to the balance hole jewel in the balance cock, and (3) Leveling the hairspring to the balance cock. These three operations are done in this order, therefore they will be discussed in this order.

Importance of Regulator Pins' Condition

Before attempting to true a hairspring to the balance cock, it is very important to have the regulator pins in proper condition and position. This is shown in Figure 1.

View A, Figure 1 shows the regulator used for a flat hairspring. This regulator has a key and a pin to control the hairspring. The key is turned one-fourth turn with a screwdriver when removing or replacing the hairspring on the balance cock. The key has a lip extending out to cover the end of the regulator pin to close up the space between the key and the pin. The space between the key and the regulator pin should always be parallel and allow adequate space for the outside coil of the hairspring.

View B, Figure 1 shows a regulator for an overcoiled hairspring. This style of regulator has two regulator pins as well as a key. This style is used by Bulova. The closed key prevents a coil of the hairspring in the body of the hairspring from getting caught between the regulator pins if the watch should get a sudden shock.

View C, Figure 1 shows a regulator for an overcoiled hairspring. This style of regulator is mostly used for overcoiled hairsprings.

View D, Figure 1 shows another view of the regulator pins which shows them lined up with each other. The pins should be straight and at a 90° angle with the regulator.

View E, Figure 1 shows a hairspring that has been bent between the regulator pins and the hairspring stud as the regulator was moved toward the slow side of the regulator scale. This condition was caused by the regulator pins being too tight on the regulator sweep of the hairspring. The regulator pins should always be adjusted so there is adequate clearance on the regulator sweep of the hairspring between the pins.

Shaping the Flat Hairspring at the Stud

The hole in the balance cock for the stud of a flat hairspring is always placed a greater distance from the jewel hole than the distance that the regulator pins are placed from the jewel hole. This practice is to allow clearance between the stud and the second coil of the hairspring when the hairspring is breathing. Since the hairspring stud is farther from the center than the regulator pins, we must shape the hairspring inward at the stud in order to circle the regulator sweep of the hairspring. This is shown in Figure 2.

View A, Figure 2 shows a flat hairspring after it has been pinned at the stud and before it has been shaped at the stud. At this stage, the hairspring needs to be shaped at the stud to allow the regulator sweep to be circled for the regulator pins. Note that the hairspring collet is off-center with the jewel. This is caused by the stud position being farther from center than are the regulator pins.

View B, Figure 2 shows the hairspring after it has been shaped at the stud with a dog-leg shaped bend. This bend should be a rounded double bend. Tweezers that have jaws which are rounded inside can be used to form this double bend.

View C, Figure 2 shows another pattern that can be used for shaping the outside coil of a flat hairspring when circling the regulator sweep. This pattern allows for two dog-leg bends on the outside coil of the hairspring, one at the stud and another just beyond the regulator sweep. This is a more modern approach to shaping the outside coil of a flat hairspring.

Circling the Regulator Sweep of a Flat Hairspring

Figure 3 shows a flat hairspring after the regulator sweep has been circled and centered between the regulator pins. Note that when the regulator is set on center and at the fast and slow positions, the hairspring is still centered between the regulator pin and key. Anywhere between the slow and fast positions, the hairspring should be centered between the pin and key. The lip on the bottom of the regulator key has been removed in the illustration in order to show the space between the key and the pin.

Figure 4 shows the procedure used for circling the regulator sweep of a flat hairspring. This operation is started with the regulator set in the slow position as shown in View A. Note that in this position of the regulator, the hairspring is resting against the regulator pin. To correct this condition, the outside coil is pulled outward near the stud to center the hairspring between the key and the regulator pin.

View B, Figure 4 shows the regulator after it has been advanced to position "a." In this position, the hairspring is resting against the regulator key. To correct this condition, the regulator is backed up to position "b," then the outside coil is pushed in against the regulator pin to bend the coil inward so it will be centered between the key and the pin when the regulator is returned to position "a."

View C, Figure 4 shows the next step in circling the regulator sweep. The regulator is now advanced toward the fast side to position "a." In this position, the outside coil is resting on the regulator pin. To correct this condition, the regulator is backed up to position "b" and the coil is pulled outward against the regulator key to bend the coil outward so it will be centered between the key and the pin when the regulator is returned to position "a."

View D, Figure 4 shows how the regulator sweep is checked to make sure that it is centered between the key and the pin at all positions of the regulator from the slow to the fast positions. A good final test of the regulator sweep circling is to move the regulator from slow to fast as the hairspring is observed. There must not be any movement of the hairspring as the regulator is moved through its complete range. If there is any movement, the regulator sweep must be re-adjusted. After the regulator sweep has been formed, the hairspring is centered on the balance cock without disturbing the regulator sweep.

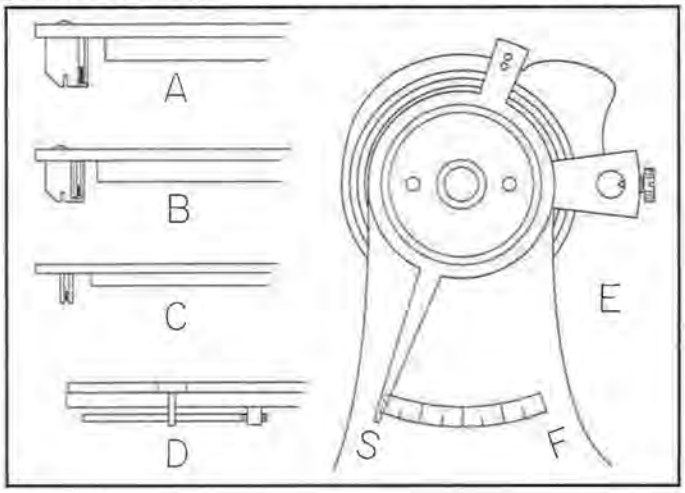

Figure 1.

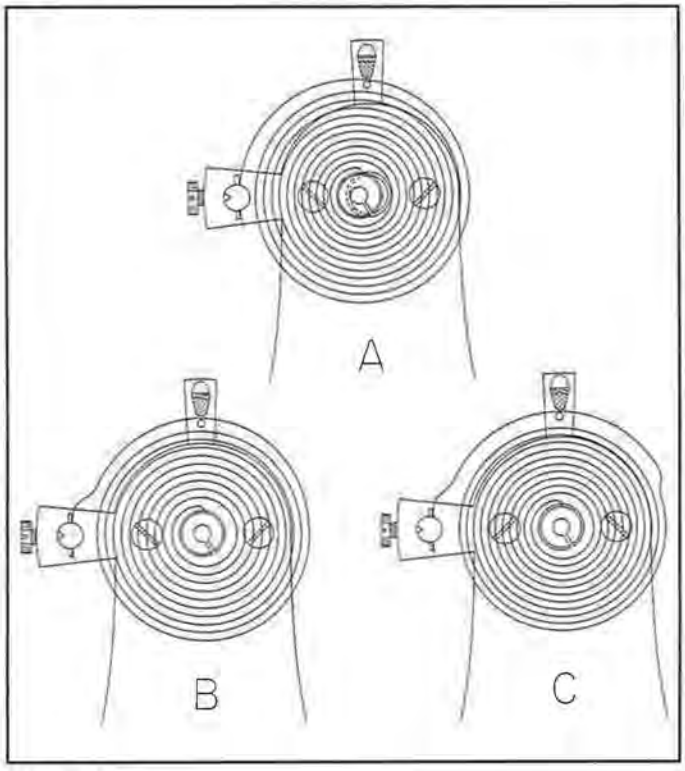

Figure 2.

Centering the Hairspring on the Balance Cock

Figure 5 shows a flat hairspring with two off-center, out-of-true conditions. View A shows a condition where the hairspring collet is off-center with the hole jewel in a direction away from the hairspring stud. The error is on the outside coil just outside the end of the regulator sweep. (See arrow, Figure 5.) This illustration shows the regulator set at the end of the regulator scale at the fast side. To center the collet with the hole jewel, the outside coil is corrected at the arrow with a pair of overcoiling tweezers or with tweezers which have rounded jaws. The outside coil is bent so its radius is decreased at the point where the arrow is located. This bend should be a very gradual bend, not sharp. The bend should be almost invisible, just enough to center the collet with the balance hole jewel. Note: It is very important that the

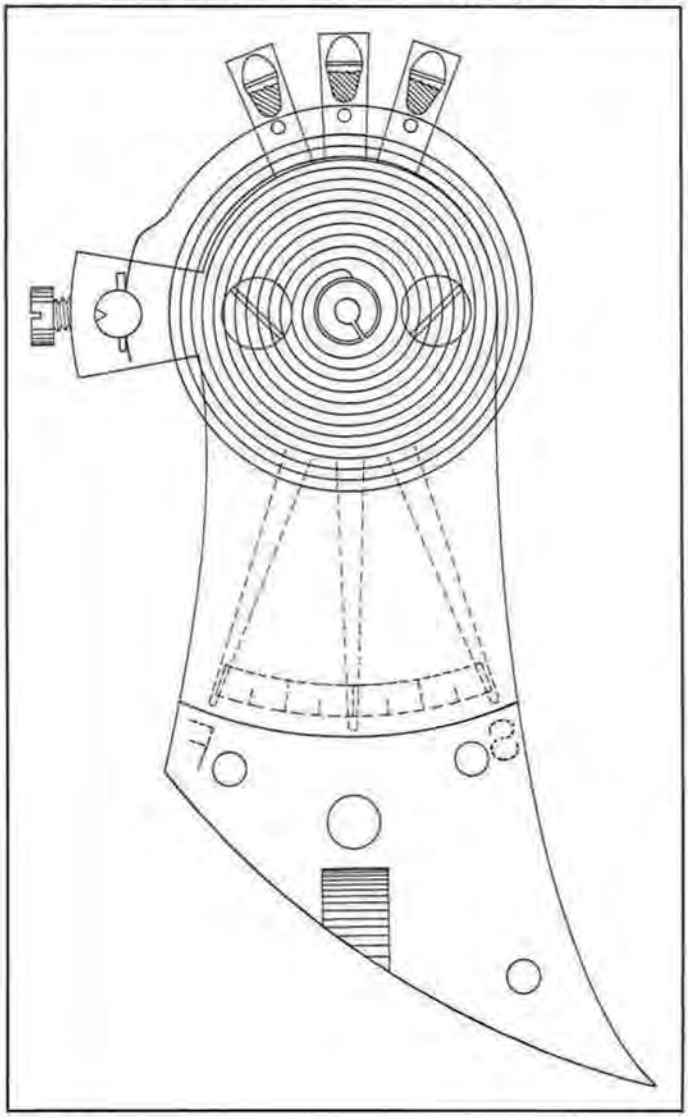

Figure 3.

hairspring has been trued on the collet before trying to center the collet with the jewel.

View B, Figure 5 shows another off-center condition. In this example, the hairspring and collet are off-center in a direction away from the regulator pins. The position of the bend is at the arrow. This bend can be corrected with overcoiling tweezers by reversing the tweezers on the bend so the concave jaw of the tweezers is on the outside of the coil and the convex jaw of the tweezers is on the inside of the coil over the bend. (See inset "a" in View B.) The bending should be kept to a minimum, just enough to center the collet with the jewel. This correction can also be made with a pair of round-jawed tweezers to hold the spring next to the bend while a needle is used to manipulate the coil of the hairspring.

Circling the Regulator Sweep of an Overcoiled Hairspring

Figure 6 shows the circling of the regulator sweep of an overcoiled hairspring. The circling is done in the same manner as for a flat hairspring. There is one difference between the two operations. The difference is that the stud's position on an overcoiled hairspring is usually the same distance from the center as the regulator pins are which makes it unnecessary to make a dog-leg bend at the stud.

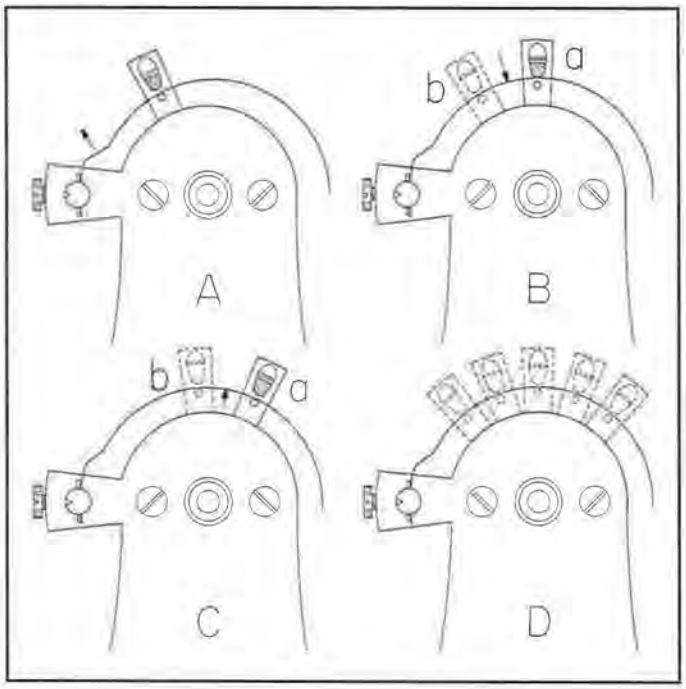

Figure 4.

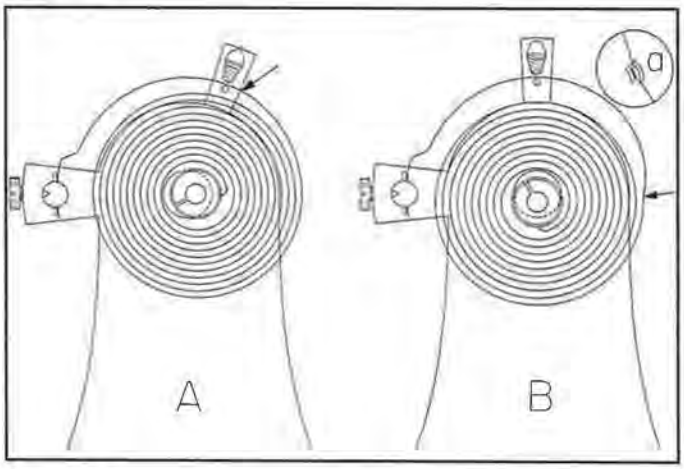

Figure 5.

Centering an Elgin Overcoiled Hairspring to the Balance Cock

Figure 7 shows how an Elgin overcoiled hairspring is centered to the balance cock. Since the Elgin overcoil is of the double quadrant type, these same procedures can be used on any double quadrant type of overcoil.

View A, Figure 7 shows a hairspring and collet that is off-center in a direction which is toward the straight part of the overcoil. The error is in the second bend which joins the regulator sweep. This is shown by an arrow. The second bend has a radius that is too long, and it must be shortened. This can be done with the overcoiling tweezers as shown in the inset in View A. By squeezing the tweezers, the bend is closed up more which will shift the hairspring and its collet to a centered position over the hole jewel. This operation can be done by holding the hairspring close to the bend with rounded-jaw tweezers and using a needle to manipulate the hairspring to center it.

View B, Figure 7 shows another off-center condition in an Elgin hairspring. In this case, the hairspring and collet are off-center in a direction away from the regulator pins. This condition is caused by the straight part of the overcoil being too long. The reason for this is that there is a sway in the straight part of the

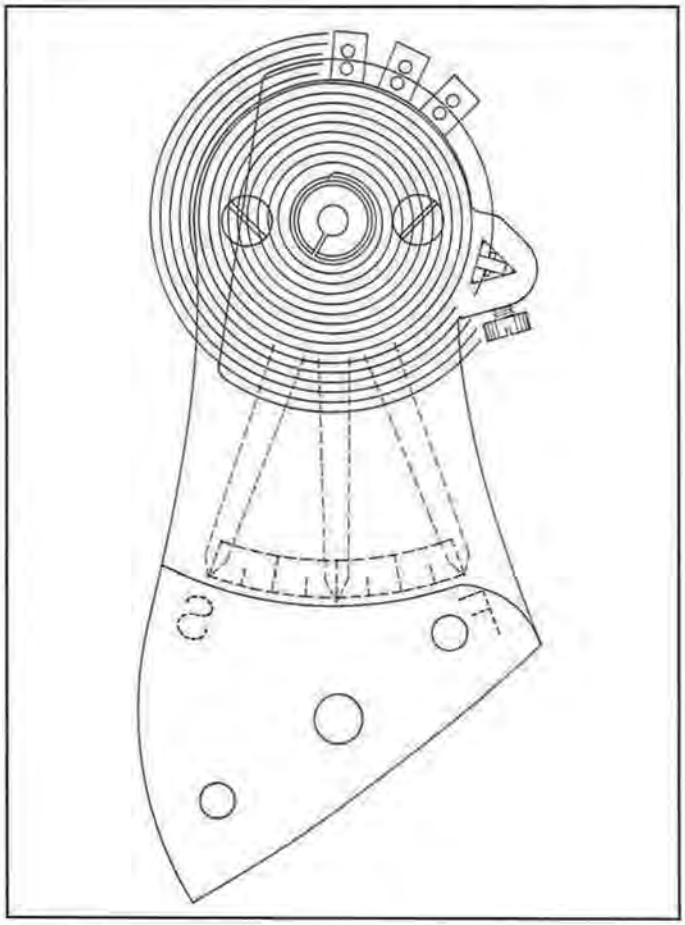

Figure 6.

overcoil. The reverse of this would be a hump in the straight part of the overcoil causing the straight section to be too short. To correct the condition in View B, Figure 7, the sway is removed making this section straight which will shift the hairspring and collet to center.

Figure 8 shows two other examples of Elgin overcoils that are off-center with the hole jewel. View A shows a condition where the hairspring and collet are off-center in a direction which is opposite the straight section of the overcoil. The error is in the first bend of the overcoil as the overcoil starts across the hairspring. This position is shown by the arrow. The radius of the bend is too long. This condition causes the straight section of the overcoil to be too far away from the center of the collet. The correction is to shorten the radius of the bend which will shift the whole body of the hairspring and its collet toward the straight section of the overcoil, bringing the collet back on center with the hole jewel. This correction can be done very nicely with the overcoiling tweezers, or it can be done with the rounded-jaw tweezers and a needle.

View B, Figure 8 shows the other example of an off-center Elgin hairspring. In this case, we have the opposite condition. The hairspring and collet are off-center in a direction toward the straight section of the overcoil. This places the straight section too close to the center of the hairspring collet. This condition is caused by the shortened radius of the first bend. (See arrow, Figure 8.) The correction would be to lengthen the radius of the bend which would shift the body of the hairspring and collet back

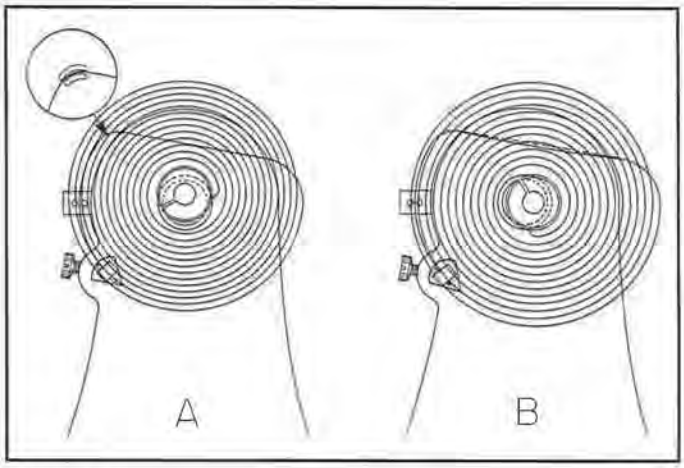

Figure 7.

on center with the hole jewel. This manipulation can be done with the overcoiling tweezers by placing the concave jaw on the inside of the bend and the convex jaw on the outside of the curve. The tweezers are squeezed just enough to correct the radius of the bend and center the collet. The bend can also be corrected with the rounded-jaw tweezers and a needle. When this bend is manipulated, the overcoil does not move; only the body of the spring moves in relation to the overcoil. When the second bend is manipulated, the straight section of the overcoil moves with the body of the hairspring.

View C shows a correctly shaped Elgin overcoil. The straight section of the overcoil encloses the first three coils from the collet

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- BLACK BACKGROUND WITH GOLD ROMAN NUMBERS

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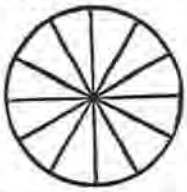

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and the regulator sweep goes between the second and third coils from the outside of the hairspring. These conditions may vary slightly from watch model to watch model.

Centering Hairsprings with Circular-Style Overcoils

Figure 9 shows three examples of off-center hairsprings that have circular-style overcoils. View A shows a condition where the hairspring and collet are off-center in a direction away from the hairspring stud. This condition is caused by a bend in the overcoil at the arrow in the illustration. The overcoil at this point is too flat or the radius of the curve is too long. The correction is to shorten the radius of the overcoil at this point which will shift the spring and collet back on center. This manipulation can be done with large overcoiling tweezers or with rounded-jaw tweezers and a needle. Care must be used to avoid making kinks in the overcoil while correcting the condition.

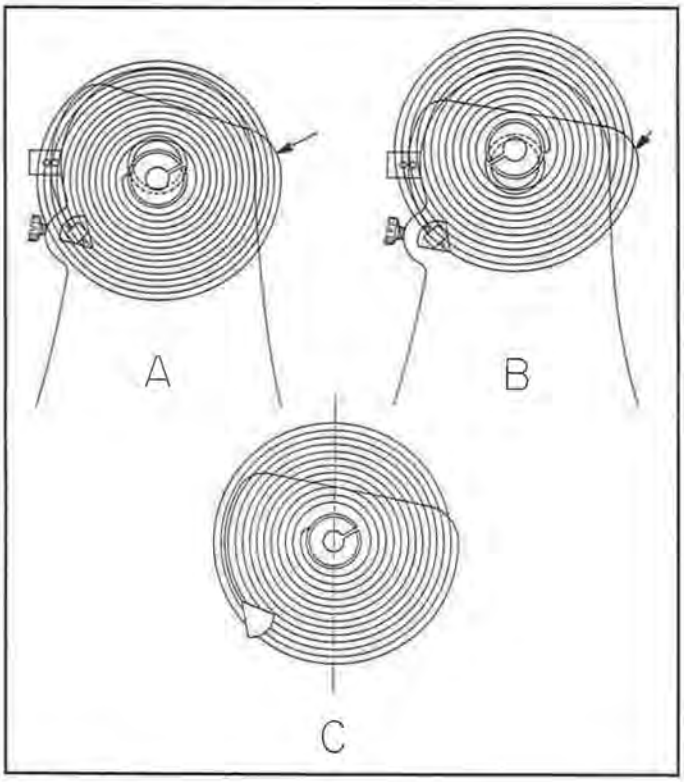

Figure 8.

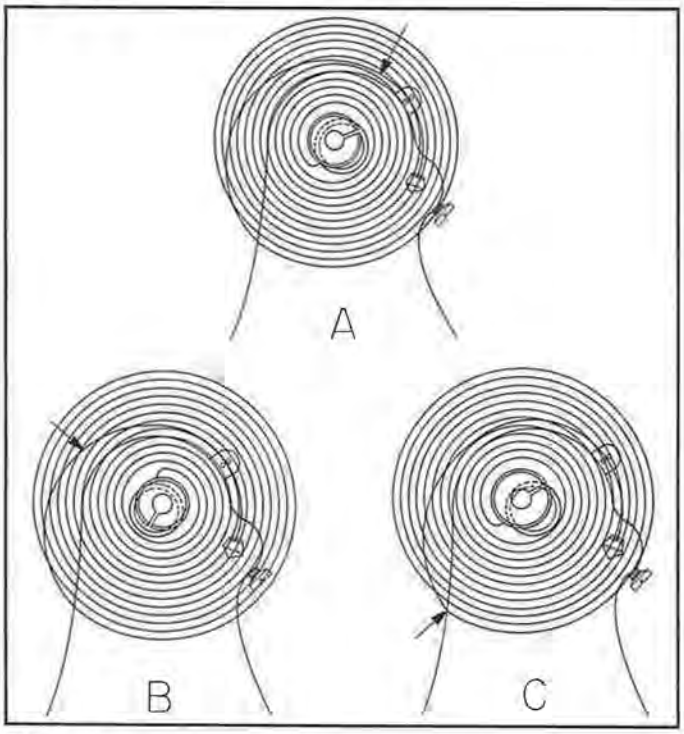

Figure 9.

View B, Figure 9 shows another off-center condition. In this example, the hairspring and collet are off-center in a direction toward the regulator pins. This condition is caused by a bend in the overcoil at the arrow. The overcoil at this point has a radius that is too short. When the radius of the overcoil is made longer, the hairspring and collet will shift back on center.

View C, Figure 9 shows the third example of an off-center hairspring which has a circular overcoil. In this example, the hairspring and collet are off-center in a direction away from the stud. This condition places the first part of the overcoil too close to the hairspring collet. This indicates that the bend is at a point where the overcoil starts across the body of the hairspring as shown by the arrow. This bend is too sharp, causing the overcoil to start across the body of the hairspring too suddenly. The correction is to round out the bend giving it a longer radius. This will cause the hairspring to shift back to center and, at the sane time, the collet will be moved away from the overcoil. When the conditions are the exact opposite to these examples, the corrections will be just the opposite.

"Antique Watch Restoration" will continue next month.

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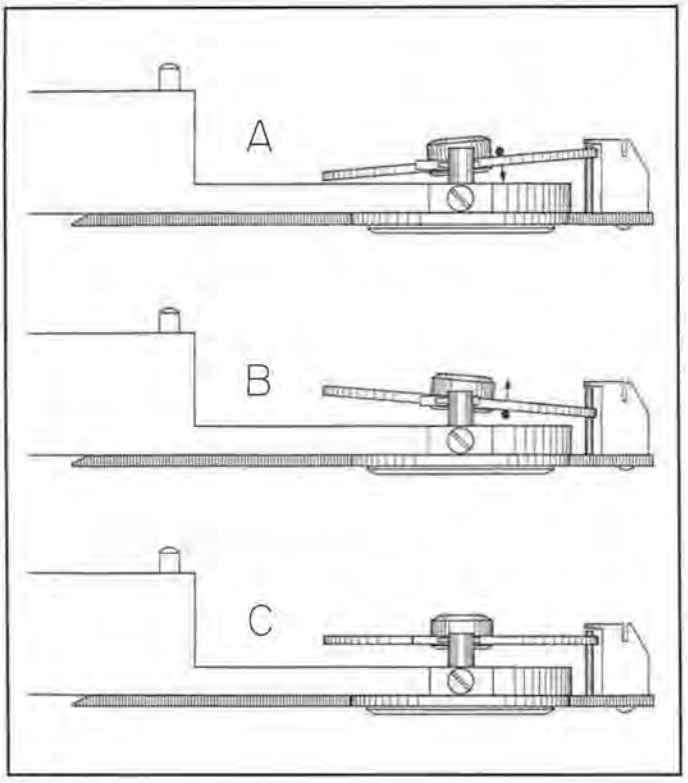

Figure 1.

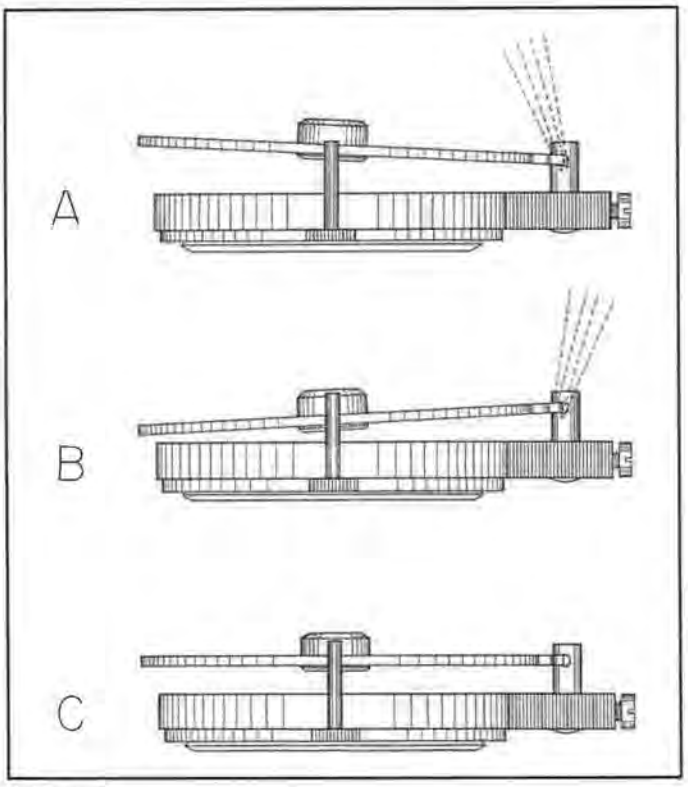

Figure 2.

TECHNICALLY WATCHES

ANTIQUE WATCH RESTORATION, PART CXXVIII

TRUING HAIRSPRINGS TO THE BALANCE COCK AND IN THE WATCH

By Archie B. Perkins, CMW, FNAWCC, FBHI
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An acceptable procedure for truing hairsprings to a watch is to first true the hairspring to the balance cock and regulator pins to correct any major conditions, then to finally true the hairspring in the watch to correct any minor conditions. After the regulator sweep has been formed and the spring centered with the hole jewel in the balance cock, the hairspring is leveled to the balance cock. After this, we must recheck the regulator sweep and the centering of the hairspring to make sure that these correct conditions were not disturbed during the leveling process.

Truing Flat Hairsprings in the Flat

Figure 1, Views A and B show a flat hairspring which is out of true in the flat 90° from the hairspring stud. View A shows a condition where the hairspring is almost touching the underside of the balance cock on one side of the collet and almost touching the lip on the regulator key on the other side of the collet. This condition is caused by an edgewise bend in the outside coil of the hairspring at the stud. The correction for this condition is to place a needle or fine tweezers jaw on the edge of the outside coil near the stud as shown and to pull down on the coil in the direction of the arrow. This is done until the hairspring is level with the underside of the balance cock.

View B, Figure 1 shows a flat hairspring that is out of flat in the opposite direction to the one shown in View A. To correct this hairspring, the needle is placed on the underside of the outside coil next to the stud, as shown, and the coil is lifted in the direction of the arrow to level the hairspring to the balance cock.

View C, Figure 1 shows the corrected hairspring. The hairspring should be viewed from the regulator pin side as well as from the stud side to make sure that the hairspring is level with the balance cock.

Figure 2, Views A and B, show a flat hairspring which is out of flat 180° from the stud. View A shows a condition where the spring is too far from the underside of the balance cock opposite the stud. The spring would be too

low opposite the stud when the balance cock is turned over in its normal operating position. This condition is caused by a twist in the outside coil near the stud. The twist in the coil is removed with the tweezers by pinching the coil near the stud as shown in broken line. The tweezers are used at the proper angle so when they are squeezed slightly, the twist will be removed and the spring leveled.

View B, Figure 2 shows an out-of-flat condition that is just the opposite to the condition that is shown in View A. The hairspring is high opposite the stud when the balance cock is turned over in its normal operating position. This out-of-flat condition is corrected with the tweezers by grasping the outside coil near the stud as shown. The tweezers are squeezed to remove the twist in the coil to level the hairspring.

View C, Figure 2 shows the hairspring after it has been leveled to the balance cock. After a hairspring has been leveled, it must be checked to make sure that its centering and regulator sweep have not been disturbed.

Figure 3, View A shows a flat hairspring in the watch that is cupped down. Note that the outside coil of the hairspring is level with the balance wheel arm but is lower than the pinning at the collet. This condition is caused by the stud being too low in its hole in the balance cock. To correct this condition, the stud is raised in the balance cock.

View B, Figure 3 shows a flat hairspring that is uniformly cupped up in the watch. This condition is the opposite to that of View A. This is corrected by lowering the hairspring stud. These conditions are greatly exaggerated in the illustrations. Ordinarily the spring would not show this much of a cupped condition and would not require the stud to be raised or lowered very much.

Checking the Overcoiled Hairspring in the Flat

Figure 4, View A shows an overcoiled hairspring fastened to the balance cock by its stud. The spring is being viewed with the regulator pins on center and the stud is to the right of center. In this view, the hairspring is level. The overcoil is level with the balance cock and the body of the spring is level with the overcoil. This is the way the hairspring should appear for it to function correctly.

View B, Figure 4 shows another view of the hairspring. In this illustration, the stud is on center and the regulator pins are to the left of center. The spring still shows to be true in the flat. Hairsprings should always be checked in these two directions when truing them in the flat. Note: Although the hairspring shows to be true on the balance cock, when it is placed in the watch, it could be cupped up or down. This can be caused by the height of the overcoil or the height of the stud.

Truing the Overcoiled Hairspring in the Flat

Figure 5 shows one of the first steps used to true an overcoiled hairspring to the balance cock. View A, Figure 5 shows an overcoiled hairspring attached to the

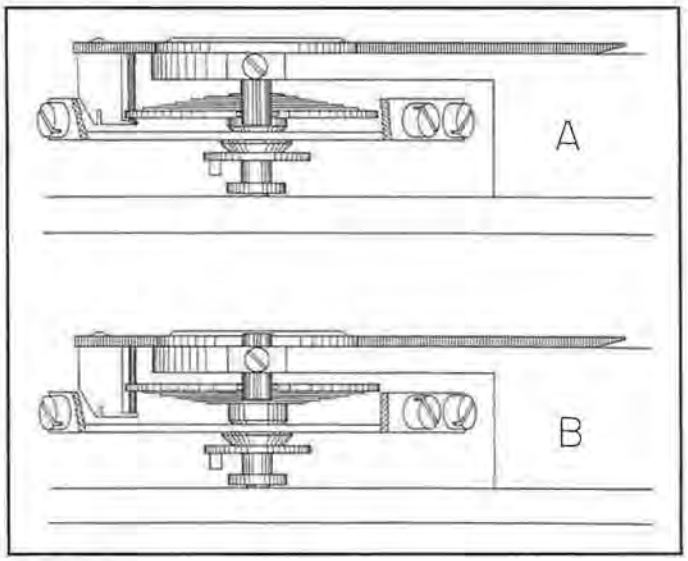


Figure 3.

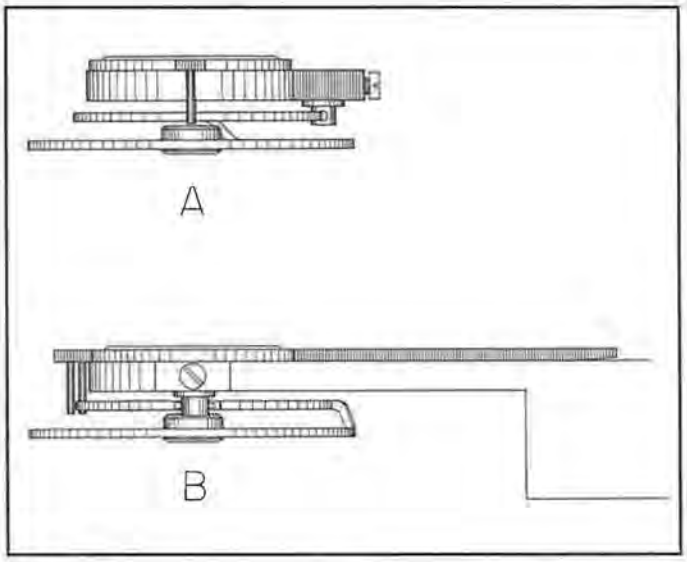
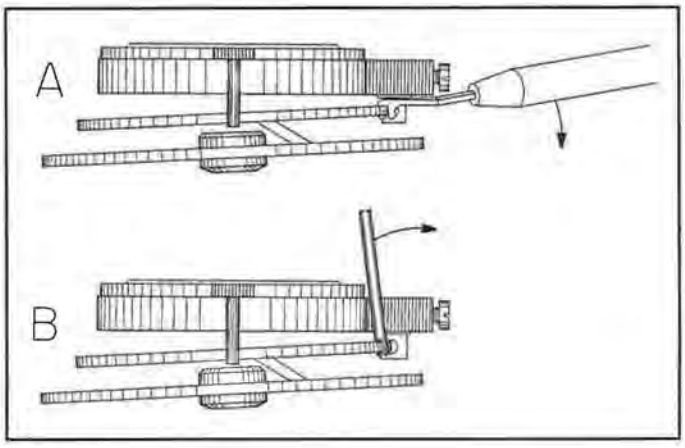


Figure 4.



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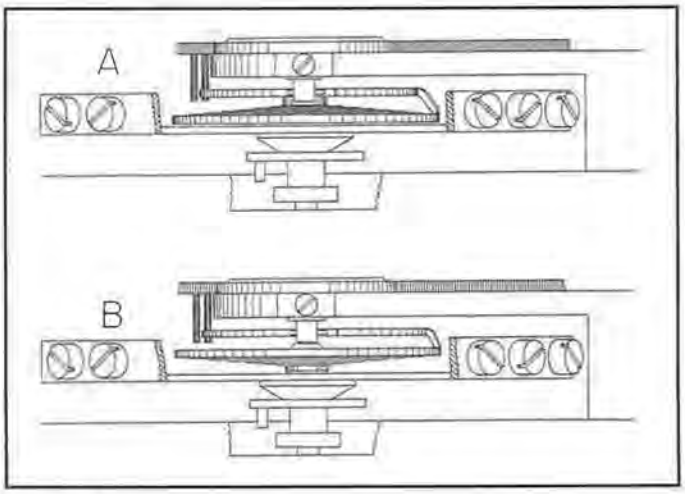

Figure 6.

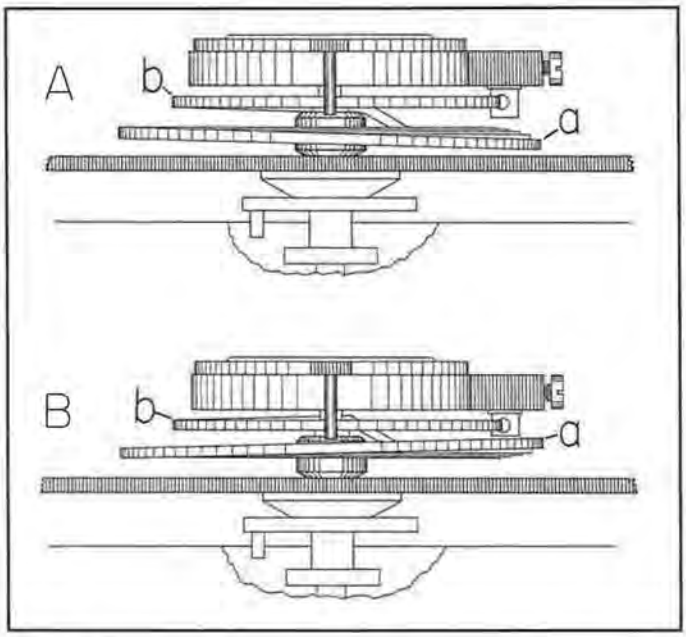

Figure 7.

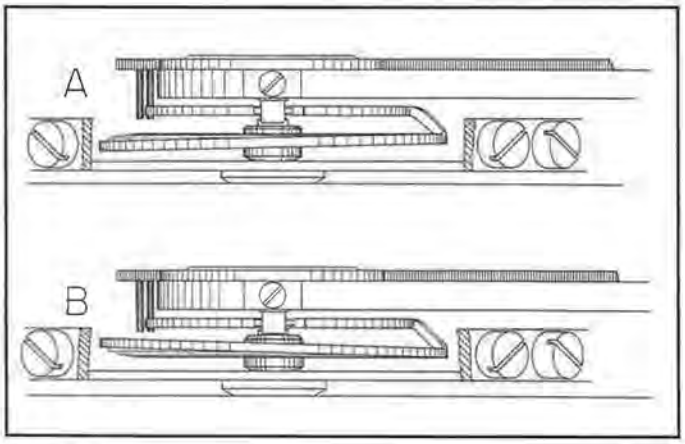

Figure 8.

balance cock by its stud. The hairspring is not level with the balance cock although the overcoil is level with the body of the hairspring. The out-of-flat condition of the hairspring in relation to the balance cock is caused by a twist in the overcoil at the stud. Usually a pair of tweezers are used to remove the twist in the coil. Sometimes it is difficult to get the points of the tweezers into proper position to manipulate the hairspring. This is because of the close space between the edge of the balance cock and the overcoil near the stud. The hairspring can be removed from the balance cock to correct the condition. Another method that can be used to remove the twist in the overcoil is by the use of a hairspring leveler as shown in View A, Figure 5. Years ago, sets of these levelers were sold by watch material suppliers. When using a leveler, the slot in the tool must not be so narrow that it gets stuck on the coil of the hairspring. If this happens, the hairspring could become damaged trying to remove the leveler.

View B, Figure 5 shows a leveler that can easily be made by the watchmaker. This leveler is made from a piece of brass or nickel silver wire. A slot is sawed in the center of the end of the wire with a circle saw. A set of these levelers can be made by using different thicknesses of circle saws for cutting the slots in different diameter wires. When removing the twist in the overcoil that is shown, the levelers are moved in the direction of the arrows. If the hairspring should be too high opposite the stud, the levelers would be moved in the opposite direction.

Overcoil Too High or Too Low

Figure 6, View A shows an overcoil hairspring in the watch. The overcoil is level with the balance cock and is about the correct distance from the balance cock. The body of the hairspring is cupped down, although the outside coil is level with the overcoil. The hairspring stud cannot be raised enough to remove the cupped condition of the hairspring. This indicates that the overcoil is too high or too far from the body of the hairspring. In this case, the high overcoil is pressing the body of the hairspring downward causing it to be cupped downward. The only solution to the problem is to lower the overcoil making it closer to the body of the hairspring. This is done by changing the height of the rise bend whether it is a gradual rise or a knee bend.

View B, Figure 6 shows an overcoil in the watch which is level except the body of the hairspring is cupped upward. This indicates that the overcoil is too low or too close to the body of the hairspring. This causes the overcoil to pull upward on the body of the hairspring causing it to be cupped upward. The stud cannot be lowered enough to level the spring. Therefore, the only solution to the problem is to raise the overcoil and make it farther from the body of the hairspring.

Leveling the Body of the Overcoiled Hairspring

Figure 7 shows an overcoiled hairspring in the watch.

The overcoil is level with the balance cock but the body of the hairspring is out of flat under the hairspring stud.

View A shows a condition where the body of the spring is low at point "a" under the stud. This condition indicates that there is a twist in the overcoil at point "b" which is opposite the stud. To correct this condition, the overcoil is manipulated at point "b" with the tweezers to raise the low point so the body of the hairspring is level.

View B, Figure 7 shows an overcoiled hairspring that has a condition that is opposite to the condition shown in the first example. In this latter case, the body of the hairspring is high under the hairspring stud at point "a." This condition indicates that the hairspring overcoil is twisted at point "b" but in the opposite direction to the twist in the first example. The twist is removed with the tweezers to lower the body of the hairspring at point "a" until the body is level. Note: When leveling a hairspring, the bend will be 180° from where the spring shows to be off the most. When centering a hairspring, the bend will be 90° from where the hairspring shows to be off the most.

Figure 8 shows two other out-of-flat conditions. View A shows a condition where the body of the hairspring is low at a point under the regulator pins. This condition is caused by a twist in the area of the rise bend. The exact point of manipulation would be 180° from where the spring shows to be off the most. The spring is manipulated to raise the low point so the body of the hairspring is level.

View B, Figure 8 shows an overcoiled hairspring with an out-of-flat body. The body is high under the regulator pins. This condition is caused by a twist in the outside coil in or near the rise bend. The exact point of the twist is located by determining the point where the spring is off the most and then going 180° from this point to locate the twist. The tweezers are used to remove the twist to level the body of the hairspring.

"Antique Watch Restoration" will continue next month.

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